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1,114,807

PATENT SPECIFICATION

DRAWINGS ATTACHED

1,114,807

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COMPLETE SPECIFICATION

Improvements in or relating to Grinding Apparatus

We, SOCIETE NATIONALE DES PETROLES D'AQUITAINE, a French Body Corporate, of 16 Cours Albert Ier, Paris 8°, France, do hereby declare the invention, for which we pray that a patent may be granted to us, and the method by which it is to be performed, to be particularly described in and by the following statement:—

The present invention relates to grinding apparatus incorporating means for producing particles or grains of similar size, automatically as desired.

An old problem which has occupied for a very long time the minds of all research workers who devote themselves to the study of rocks, whether they be mineralogists, geochemists, petrographers or crystallographers, is to obtain, from any samples having dimensional, morphological and mechanical characteristics which are as diverse as rock samples can be, powders of predetermined particle or grain size, irrespective of the nature and the form of the original material.

In the field of industrial production, success has certainly already been achieved in obtaining finished products of constant grain size, but only where the grinding apparatus is supplied with a material, all of whose characteristics themselves remain strictly constant.

On the other hand, no apparatus has up to the present time provided a satisfactory solution for the problem of the selection of grain size during grinding within the scope of laboratory studies, because then it is a question of treating numerous samples of very varied nature and of low weight. Two fundamental obstacles are then met with:

a) One part of the original sample remains "stuck" on the various parts of the grinder, so that the powder which is finally collected does not represent the whole of the sample for analysis; it is important to note that the smaller the sample more prevalent is the defect.

b) The final grain size is not determined by the individual parameters of adjustment of the apparatus, but varies with the characteristics of the material to be ground.

However, recently, partial solutions have been proposed, but they all present numerous and sometimes serious defects.

According to one arrangement which has been already proposed, a grinding apparatus for producing grains of similar size conventionally comprises a cylindrical enclosure moved alternately parallel to its axis and containing a beater ball, the grinding enclosure is provided with apertures therein on which a gauze sieve is adjusted. Compressed air is injected into the grinder and escapes through the sieve, thus driving from the enclosure the particles which are of sufficiently reduced diameter for passing through the sieve. The latter is surrounded by a collector fixed to the frame of the apparatus and connected by means of a flexible pipe to a recuperation filter which is also secured to the frame of the apparatus.

This apparatus has a number of disadvantages. Firstly, it does not permit all of the material placed in the enclosure of the grinder to be recuperated on the filter; in fact, the enclosure has a number of dead angles where it is connected to the surrounding sieve and quantities of powder which are sometimes large, accumulating in these angles; such parasitic accumulations are also produced at the collector and in the flexible pipe connecting the latter to the final filter. One thus runs a grave risk of collecting a powder which is not representative of the whole of the sample, if there has been selective sticking of a certain mineral; moreover, it is necessary, after grinding each sample, completely to disassemble and carefully clean each part of the grinder, which wastes a considerable amount of time.

Moreover, the sieve is in direct contact with the fragments of rock and it therefore undergoes violent mechanical stresses particularly at the commencement of the grinding operation,

when the rock fragments are still relatively large. In order to avoid too rapid a wear of the sieves, one is therefore obliged to use relatively large gauzes, so that the fineness of the final product cannot be very good.

Moreover, in order to avoid perforating or permanent deformation of the sieve by the pressure of these rock fragments pressing against the sieve under the effect of the ball, the latter is covered by a supporting sieve which is coarser; but the gap which separates the ball and its covering may still give rise to undesirable accumulations of material.

As the powder is collected on the filter fixed to the frame and the filter is therefore immobile, the material thus obtained is agglomerated on the filter without alteration and is thus accumulated in a heterogeneous manner, the most friable minerals arriving first; in order to obtain an homogeneous powder representative of the whole of the sample, it is consequently necessary to carry out an additional homogenisation in separate apparatus.

In another known grinder, the grinding is obtained by the mutual impingement of two or more air jets at high speed each jet carrying some of the material to be ground. The shock of the particles thus projected against one another brings about a mutual grinding action. The classification as between the sufficiently fine particles and the remainders is effected in an air cyclone; the remainders are sucked back into the grinding zone.

Although this apparatus has two important advantages, namely; on the one hand a low pollution of the sample because the grinding is effected practically without any contact with mechanical parts, and on the other hand the possibility of obtaining a finished product of very great fineness, it also has two serious defects, because on the one hand it must be supplied with a material which has already been largely preground (0.8mm diameter) and on the other hand, the fineness of the powder collected depends not only upon the parameters of adjustment of the apparatus, but also, and this is the most awkward, upon the grain-size characteristics of the material to be ground, and upon its mechanical characteristics. Moreover, as in the case of the aforementioned grinder, the material finally obtained must, in order to be representative of the sample to be studied, undergo a homogenisation in a separate apparatus.

The present invention seeks to remedy or palliate the disadvantages and has for a particular object to produce apparatus for grinding material to particles or grains of similar size, which does not necessitate a supply of pre-ground material, does not cause considerable wear of the sieve, allows substantially all the material constituting the load of the grinder to be collected and thus does not necessitate a cleaning after each grinding operation, and which permits a representative sample to be collected with an extremely good homogeneity of the final powder whose grain size is not influenced by the nature of the material treated.

According to the invention there is provided apparatus for grinding material into particles or grains of similar size, comprising, a grinding chamber, containing one or more beater balls or like members and capable of being operatively moved with a rapid periodic alternate movement parallel to the vertical axis of the chamber, and wherein a selecting chamber is connected to the grinding chamber by input and output or return passages, a duct being connected to a source of compressed air and the input passage in such a manner that air is sucked from the grinding chamber and discharged into the selecting chamber, and a sieve is provided to separate the selecting chamber from a collecting chamber having an air-permeable filter, and a recuperator-homogenizer removably mounted on the apparatus communicating with the collecting chamber and being provided with a non-return member preventing any return of the material contained in the recuperator-homogenizer to the collecting chamber.

The collecting chamber may be subdivided by a diaphragm provided with a calibrated aperture, into a precollecting chamber and an actual collecting chamber, the pre-collecting chamber being defined by the sieve and said diaphragm.

The input passage may be semi-circular in shape, and the duct connected to the source of compressed air may lead tangentially into this channel in the direction of the selecting chamber.

The diameter of the input passage may be smaller than the diameter of the return passage.

The input passage preferably leads into the selecting chamber so that the extension of its axis towards the selecting chamber is substantially tangential to the sieve.

The selecting chamber, the pre-collecting chamber and the collecting chamber may each be provided with a moving member, and this moving member may be constituted by a disc provided with stiff but flexible wires.

In order that the invention may be more readily understood, one embodiment of a grinding apparatus according thereto will now be described with reference to the accompanying drawings in which:—

Figure 1 shows an axial section through the apparatus according to the invention, and

Figure 2 shows a section through the grinder along the staggered line II—II of Figure 1.

Referring now to the drawings, in a body 1 of a grinder 2 there is provided a grinding chamber 3 whose internal walls are preferably rounded and which is closed at its upper end by a closed removable cover 4. The grinder is mounted on a support (not shown) which

can be moved with a very rapid alternate movement parallel to the vertical axis I—I of the grinding chamber 3. A beater ball 5 intended for grinding material 6 is provided in the grinding chamber 3. The beater ball may be of any desired shape, both as to shape and as to principle of operation, provided that it is sealed and capable of being moved by a rapid periodic alternate movement.

A selecting chamber 7 arranged to the side and preferably connected near its ends to the grinding chamber 3 by means of two passages which may be referred to respectively as the input passage 8 and output passage 9, the passage 8 for removing the material which has already been ground in the chamber 3 to the chamber 7, and the passage 9 for returning to the grinding chamber 3 the remainders from the selecting chamber 7. Into the input passage 8, preferably semi-circular in shape, there leads a duct 10 in the direction of the chamber 7 and connected to a source of compressed air (not shown in the drawing). This duct 10, by its particular arrangement, ensures the constant circulation of the air contained in the grinding chamber 3 towards the selecting chamber 7, by means of the input passage 8, and its return from the chamber 7 into the chamber 3 by means of the output or return passage 9.

In the embodiment shown in the drawing, a sieve 11 separates the selecting chamber 7 from a pre-collecting chamber 12 situated on the other side of the sieve 11, itself separated from a collecting chamber 13 by a diaphragm 14 having a calibrated aperture 15 therethrough at its centre. The calibrated aperture 15 has a greater diameter than that of the meshes of the sieve 11. The collecting chamber 13 is defined by an air-permeable filter 16, constituted for example by sintered material e.g. sintered metal, or in a more conventional manner by a porous membrane made of paper or any other material.

In a modification, the diaphragm 14 may be eliminated, so that the collecting chamber is directly defined by the sieve 11 and the filter 16.

A recuperator-homogeniser 17 is removably mounted on the grinder 2 and into whose chamber the powder stopped by the filter 16 of the collecting chamber 13 may enter without the possibility of returning rearwardly due to the presence of a non-return member 18 constituted by a baffle-plate, disposed on the aperture placing the collecting chamber 13 into communication with the recuperator 17.

Moving members (not shown in the drawing) whose function is to effect a permanent cleaning of the walls of said chambers are preferably located in the selecting chamber 7, pre-collecting chamber 12 and collecting chamber 13; the moving member which is located in the selecting chamber 7 is arranged so as to effect, in addition, vibration of the selecting sieve 11, in order to ensure that it shall always remain unclogged.

The assembly constituted by the grinding chamber 3, selecting chamber 7, pre-collecting chamber 12, collecting chamber 13, and the recuperator-homogeniser 17, constitutes, when assembled, a compact unit. The injector duct 10 connected to the source of compressed air opens out into the input passage 8 tangentially to the axis of the latter and in the direction of the selecting chamber 7. The diameter of the input passage 8 is smaller than that of the output or return passage 9. The input passage 8 preferably opens out into the selecting chamber 7, so that the extension of its axis towards said chamber 7 is substantially tangential to the sieve 11.

Of course, the induction pump or air pump may be one of many kinds: thus the injection of the compressed air may be effected either in the input passage 8, or in the selecting chamber 7, so as to create a pressure reduction or suction in the input passage 8 with respect to the grinding chamber 3. The injection of compressed air into the input passage may be effected axially or laterally and tangentially, through a tube, or a slit, or by annular injection, etc.

The operation of a grinder according to the invention is as follows:

Fragments of rock 6 to be ground are introduced into the grinding chamber 3. Having closed the grinder 2, its compressed air supply is opened, then it is moved rapidly and alternately and parallel to its axis.

The air contained in the grinding chamber 3, therefore loaded with dust, is sucked through the aperture connected to the input channel 8, is mixed with the moving air of the injector duct 10 and arrives in the selecting chamber 7. A part of the air (corresponding to the permanent contribution of the moving air) passes through the sieve 11, driving with it the particles which have reached a sufficiently small dimension in order to pass through, whilst another part (corresponding to the outflow sucked in the grinder) returns to the grinding chamber 3 through the output or return passage 9, returning with it the remainders from the sieve 11, the remainders will then undergo a new grinding operation. This permanent recycling permits all the particles having achieved the desired particle or grain size to be drawn off after their formation. This is doubly advantageous: any useless (and for certain analyses, disastrous) excess grinding, is avoided and the efficiency of the grinder is increased because its power is no longer reduced by a fine sieve protecting the grains to be ground.

The moving member, moving freely in the selecting chamber 7, ensures the permanent cleaning of the walls of the chamber 7, on which particles could stick, and effects a permanent vibration of the sieve 11, thus avoiding

any clogging. This moving member may, for example, be constituted by a disc provided with stiff but flexible wires which vibrate by "gripping" the sieve 11. The powder which has passed through the sieve 7 is driven by the air through the pre-collecting chamber 12 and arrives through the calibrated aperture 15 of the diaphragm 14 in the collecting chamber 13 where it is deposited as a cake on the filter 16. The moving member of this latter chamber 13 permanently detaches this cake which falls, through the aperture 19 provided with a non-return baffle plate 18, into the recuperator-homogeniser 17.

It is advantageous to use the diaphragm 14 separating the pre-collecting chamber 12 and collecting chamber 13, the function of this diaphragm is to avoid the lumpy pieces detached from the filter 16 being projected towards the sieve 11, thus uselessly soiling the rear face of the latter. Due to the high speed of the air passing through the aperture 15 of the diaphragm 14 into the collecting chamber 13, such a counter-flow return is impossible.

The powder which has fallen into the recuperator-homogeniser 17 is violently shaken for as long as the grinding lasts and is thus perfectly homogenised.

The advantages of the grinder according to the invention are as follows:

Only the internal diameter of the grinding chamber 3 limits the dimensions of the fragments of rock which may be ground; a grinder of nominal load 5g accepts fragments of rocks of 25 mm diameter (this limit is taken to 35 mm diameter for a nominal load of 50g). The only particles coming into contact with the sieve 11 are of reduced dimensions (calibrated by the input passage 8), so that there is substantially no excess wear of the sieve 11.

Moreover, there is no dead space capable of retaining particles, i.e. no space not subjected to the operations either of the ball 5 of the grinder 2 or by the moving members of the chambers 7, 12, 13. Thus, the powder obtained in the recuperator 17 represents all the sample without risk of any selective loss; moreover, cleaning operations are practically eliminated. The homogenisation of the powder constituting the sample collected in the recuperator 17 is obtained in the same operation as the grinding. The particle or grain size of the final sample is independent of the characteristics of the material to be ground.

Of course, the previously described embodiment shown in the drawing has been given only by way of non-limiting example, and may be modified as desired. For example, the shape of the input channel is not necessarily circular. Moreover, the grinding chamber, instead of having a cylindrical shape and rounded at its ends could have a spherical shape.

WHAT WE CLAIM IS:—

1. Apparatus for grinding material into particles or grains of similar size, comprising, a grinding chamber, containing one or more beater balls or like members and capable of being operatively moved with a rapid periodic alternate movement parallel to the vertical axis of the chamber, and wherein a selecting chamber is connected to the grinding chamber by input and output or return passages, a duct being connected to a source of compressed air and the input passage in such a manner that air is sucked from the grinding chamber and discharged into the selecting chamber, and a sieve is provided to separate the selecting chamber from a collecting chamber having an air-permeable filter, and a recuperator-homogenizer removably mounted on the apparatus communicating with the collecting chamber and being provided with a non-return member preventing any return of the material contained in the recuperator-homogenizer to the collecting chamber.

2. Apparatus as claimed in claim 1, wherein the selecting chamber is connected near its two ends to the grinding chamber.

3. Apparatus as claimed in claim 1 or 2, wherein the collecting chamber is subdivided by a diaphragm provided with a calibrated aperture, into a pre-collecting chamber and an actual collecting chamber, the pre-collecting chamber being defined by the sieve and the diaphragm.

4. Apparatus as claimed in claim 1, 2 or 3, wherein the input passage is semi-circular in shape, and into which the duct connected to the source of compressed air leads tangentially in the direction of the selecting chamber.

5. Apparatus as claimed in any one of the preceding claims, wherein the diameter of the input passage is smaller than that of the output or return passage.

6. Apparatus as claimed in any one of the preceding claims, wherein the input passage opens into the selecting chamber such that the extension of its axis towards the selecting chamber is substantially tangential to the sieve.

7. Apparatus as claimed in any one of the preceding claims 3 to 6, wherein the selecting chamber, the precollecting chamber and the collecting chamber are each provided with a moving member.

8. Apparatus as claimed in claim 7, wherein the moving member is constituted by a disc provided with stiff but flexible wires.

9. Grinding apparatus, substantially as hereinbefore described with reference to the accompanying drawings.

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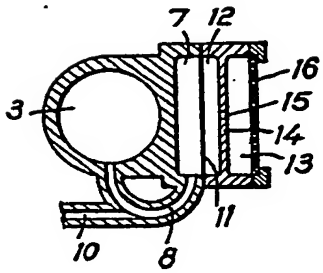
1 SHEET *This drawing is a reproduction of the Original on a reduced scale*

Fig. 2



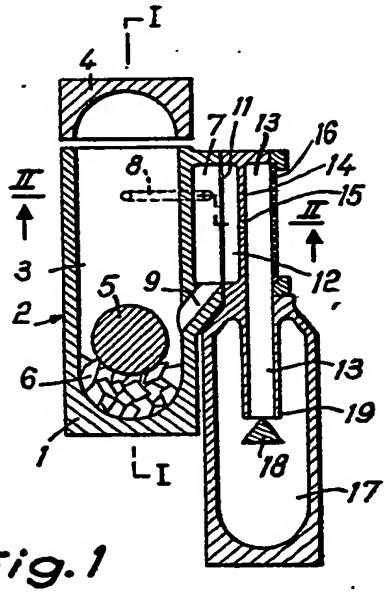


Fig. 1